IX. Appendix D: Switch Modeling Definitions and Assumptions, cont.

- Coin Service: This is equipment and software used for public and semi-public pay phone services (coin and credit card) for connection with the PSN and with operator service.

Switch Capabilities Assumed in Model

SS7 and MF signaling
SSP capable
Call recording for billing
Announcements and tones for call processing
Basic testing and maintenance functions
Access to:
- — Operator services: includes directory assistance
- — Tandem switches: includes tandem signaling
- — IXCs (equal access)
- — Wireless carriers: cellular (Type I, II, and IIA) and PCS

Residential, single-line business, and multi-line business services
Centrex
CLASS services
ISDN/wideband video
Voice mail
E 911/911
Coin service

Description of Types of Wireless Connection with a LEC Network

The following are definitions for the various types of cellular interconnection facilities or arrangements adapted from Bellcore, *Interconnection of WSP/LEC Network* "Interconnection Types," TR-NPL-000145, Issue 2, December 1993, page 2-1.

Type I:
The cellular switch connects to the LEC local switch (end office or Class 5). The LEC provides more functions and the cellular switch functions like a ***Private Branch eXchange (PBX)***. The LEC switch provides directory numbers (the database of telephone numbers, or NXX codes).

Type IIA:
The cellular switch connects to a LEC tandem switch. In this case the NXX data base can reside in the cellular switch. The cellular switch provides the equivalent of LEC Class 5 switching. Result is that the Type IIA cellular company pays the LEC a lower price than Type I cellular companies.

IX. Appendix D: Switch Modeling Definitions and Assumptions, cont.

Type IIB:
The cellular switch connects to a specific LEC end office but in conjunction with a cellular Type IIA interconnection facility. Any overflow traffic in excess of the capacity of the Type IIB is handled by the Type IIA facility.

Type IIC:
The cellular switch connects to a LEC tandem office that provides E911 calls.

Type IID:
The cellular switch connects to a LEC tandem that provides LEC operator assisted calls or directory service using SS7 or MF.

Type S:
The cellular switch connects to a LEC for STP for access to the Common Channel Signaling (CCS) network.

Requirements for Ports: Trunk Side and Line Side

The following chart compares the technical differences between trunk side and line side connections to the LEC switch.

Trunk Side Port Requirements:	*Line Side Port Requirements:*
Signaling: Seizure Digit transmission:[a] Start End Idle	Signaling: Off-hook On-hook Ringing Busy Digit Collection (using tones or pulses)
Usually Digital Transmission	Usually Analog Transmission
Many Trunks per Wire/Fiber	Loop Requires at Least 2 Wires
1 Port for Many Trunks	1 Port per Loop

[a]With SS7, the trunk may not have to recognize the transmission of digits (the telephone number). With MF signaling, the trunk must be able to recognize the transmission of digits.

Sources for Figure 4 and Switch Modeling —
Switch Traffic and Usage Statistics: Telephone Network

Percent of U.S. Households with Service
93.9% annual average for 1995. FCC, *Telephone Subscribership in the United States*, Washington, DC, February 27, 1996, page 17.

IX. Appendix D: Switch Modeling Definitions and Assumptions, cont.

Holding Time per Connection (Call Duration):
Traditionally, the average length of time per individual connection was 2.45 minutes per call (147 seconds per call). Information derived from Bellcore, *LATA Switching Systems Generic Requirements*, 1989, Section 17, Issue 3. The model assumes 5 minutes per call (300 seconds per call) for 1995 based on 1995 and 1996 samples from data used to determine average switch size described earlier in **Appendix D**.

Capacity — Trunk to Line Ratio:
The largest percent of loops (lines) that can be routed to a destination beyond the switch at any given time. This is one measure of peak capacity. The assumptions used in the model were a 1:6 ratio of trunks to lines (16.7%) for a small switch and a 1:5 ratio (20%) for a large switch. The actual range for this ratio may be as high as 1:4 or as low as 1:10. In the case of the lower ratio, the majority of originating and terminating calls are made among customers whose lines attach to the same switch (intra-office). The ratios are based on based on 1995 and 1996 samples from data used to determine average switch size described earlier in **Appendix D**.

Capacity — Percent of Loops in Use:
The largest percent of loops (lines) in use. This is a second measure of peak capacity but this is not an engineering criteria and, therefore, not used in the model.

Capacity — Line Concentration Ratio:
This is the number of loops whose traffic is channeled into a single path by a line concentration module. As traffic volumes increase, line concentration ratios need to decrease. Therefore, more line concentration modules are needed. If there are not enough modules, the customer may not even hear a dial tone and is unable to make the call. This ratio is a third measure of peak capacity. Historically, line concentration ratios have decreased. The ratios are based on based on 1995 and 1996 samples from data used to determine average switch size described earlier in **Appendix D**. The assumption for the model is a 6.1 ratio of loops to a path.

Busy Hour Call Volume per Hour:
The number of calls a switch must be able to handle during its busiest hour, called the peak load time. The call volume is based on three times the line capacity for a small switch and four times the line capacity for a large switch. However, these multipliers can be as high as six times the capacity depending on the demographics of the customers connected to the switch (urban/rural, business center/residential, government/private sector, number of switches in the extended calling area, etc.). Using the above assumptions, the busy hour call volume per hour was 3,600 calls for a small switch and 100,000 calls for a large switch.

Call Completion:
Percent of calls completed (destination point answers the call). Switches are engineered for 99% call connection. However, these actual percentage of completed calls is lower due to various factors, such as customers hanging up before the call is answered, customers receiving a busy signal because the party called is already on the line, or the person on the

other end never picks up the phone. The range used in the modeling was 80-85% based on 1995 data from sample LECs.

Sources for Figure 4 —
Internet Network Statistics

Percent of U.S. Households with Service
Data for 1996, 4.1 million U.S. households have at least one Internet user who connects to the Internet from home. This number is divided by a total number of U.S. households of 98.2 million to give result of 4%. Find/SVP, *The American Internet User Survey*, page iv. Also total number of U.S. households from Find/SVP, *The American Internet User Survey: New Survey Highlights*, at http://etrg.findsvp.com/features/newinet.html, April 5, 1996.

Holding Time per Connection:
American Internet User Survey, page 38. The average session length is 68 minutes.

There is a controversy over the estimated number of Internet users. A number of factors alter the results: age (what constitutes an adult), location, use (if there is an Internet user in the household but the home itself does not have a computer, how is this counted?), survey size and sampling method, and other assumptions. This paper uses the lower estimate from Find/SVP, since some studies included Canadian or e-mail users. See also http://www.cyberatlas.com/market.html, April 5, 1996, which gives a range from 6.4% to 8.4% for households with access to Internet's Worldwide Web. See also, Peter H. Lewis, "In a Recount, Cyber Census Still Confounds," *The New York Times*, April 17, 1996, pages D1 and D5, for a discussion of this debate. The Internet usage in **Figure 4** does not cover which on

The following are some statistics from various studies for the purposes of comparison:

- Find/SVP, *The American Internet User Survey,"* The Emerging Technologies Research Group, Find/SVP, New York, NY, February 1996. All numbers are for mid-November to mid-December 1995. From personal communication on March 21, 1996.

  6.4% of U.S. households have an Internet user within the household but might use it elsewhere and 9.5 million people use it in general, page iv. The average use per week is 6.6 hours for overall usage from anywhere, 7.2 hours in a household if only an adult (18 years and older) uses it, and 9.4 hours in a household if both adults and children use it.

- Nielsen Interactive Services - Press Release, *The CommerceNet/Nielsen Internet Demographics Survey, Executive Summary*, from http://www.nielsenmedia.com/whatsnew/execsum2.html, on March 21, 1996.

The Nielsen study has 24 million, or 11%, of the total population of U.S. and Canada (16 years or older, with a weighting to adjust for gender bias) used any aspect of the Internet within past 3 months. In addition, 6.7% had access to the Internet at home. The average Internet use within the past three months for all persons in the study was 5 hours and 28 minutes per week. The average use for on-line services was 2 hours and 29 minutes per week.

Sources for Figure 4 —
Cable TV Network Statistics

Percent of U.S. Households with Service
In 1994, 64.4% of U.S. households with televisions subscribed to basic cable service. National Cable Television Association, *Cable Television Developments*, Washington, DC, Fall 1995. To develop the percent of households with cable TV service, the 64.4% was multiplied by number of households with televisions in 1994 (98.3%). Data for 1994, U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, *Statistical Abstract of the United States, 1995, 115th Edition*, U.S. Government Printing Office, Washington, DC, 1995, Table 897, page 571. The calculated result is 63.3% of households with basic cable service.

Holding Time per Connection
For cable TV households, the total hours of TV viewing (both broadcast and cable) per week is 59.2 hours (59 hours and 12 minutes). The average weekly viewing time for households with cable TV basic service is 22 hours and 22 minutes for the 1994/1995 broadcast year. Cablevision Ad Bureau, *1996 Cable TV Facts*, New York, NY, 1966, "Total Hours of Viewing per Week", page 30, and "Average Weekly Viewing in All Cable HHs (Hours: Minutes)", page 15.

Capacity
A cable TV company continuously broadcasts its signal and therefore all its customers (100%) are connected. However, the specific measures for capacity, busy hour call volume, and call completion in **Figure 4** apply only to traditional LEC local switch architectures. These do not translate to the current cable TV network which typically has a bus architecture, uses an Ethernet portocol (with cable modems), is a shared facility, and has no switch to manage contention for capacity. Industry wide standards do not exist for the newer broadband networks being constructed by cable TV companies.

X. Notes

Notes: Section I, Introduction

1. *Telecommunications Act of 1996*, Pub. L. No. 104-104, February 8, 1996. For more details, see U.S. Congress, House of Representatives, 104th Congress, 2d Session, Report 104-458, *Telecommunications Act of 1996, Conference Report to Accompany S. 652.*

2. FCC, *In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996*, CC Docket No. 96-98, *Notice of Proposed Rulemaking*, FCC No. 96-182, April 19, 1996 [hereinafter referred to as *Interconnection Proceeding*].

3. For a discussion of these cycles, see, Carol Weinhaus and Anthony Oettinger, *Behind the Telephone Debates* [hereinafter referred to as *Behind the Telephone Debates*], Ablex Publishing Company, Norwood, NJ, 1988, Chapter 2, pages 5-14.

Notes: Section II, LEC Switch, Transport, and Local Loop

4. The court decision breaking up AT&T also created new boundaries for LEC service territories, called ***Local Access and Transport Areas (LATAs).***

5. *Telecommunications Act of 1996*, Sec. 271(c)(2)(B).

6. For a wireless transmission, the path may be entirely wireless or may have both wire and over-the-air components. Wireless networks provide services such as cellular, PCS, paging, and mobile radio. The Act refers to wireless companies as "Commercial Mobile Service (CMS)" providers, *Telecommunications Act of 1996*, Sec. 253(e).

   Also, in the context of federal and state tariffs, the term "access lines" implies connection to the PSN.

7. For a discussion of the role of tandem switches and transport, see Weinhaus, Carol and Seaver, Rob, et al., *Interim Report of the Alternative Costing Methods Project: An Example of Modeling an Issue – Transport: Equal Charge for Equal Unit of Traffic.* Program on Information Resources Policy, Harvard University, April 19, 1991, pages 8-17.

8. There are always exceptions to the rules and, in some cases, these exceptions are significant. Sometimes two switches are connected through line side ports and sometimes loops are connected through trunk side ports. For example, large business customers may use their own switches, called PBXs, to connect to the trunk side ports. Similarly an IXC may have a line side connection.

9. "In 39 million U.S. households, at least one person has a home office — up from 36 million in 1994." Also, 6 million people telecommuted to their job from home in 1995. From *USA Today*, "USA Snapshots®: Working More at Home," April 12, 1996, Section B, page 1. Original source for article is IDC/Link 1995 Home-Office Market Update.

10. In this paper, the term "ALT" refers to a service provider. It should be noted that the term "ALTS" refers to a trade association called the Association for Local Telecommunications Services.

11. The court decision breaking up AT&T also created LATAs, and the POPs.

12. The diagram is a simple configuration. Often the POP connects to a LEC tandem switch. Therefore, other access configurations might include additional switches and trunks. Also, a small rural company often connects to a larger LEC's tandem switch to reach the POP to connect to the PSN. The *AT&T Plan of Reorganization* defined the POP in order to implement the ***Modification of Final Judgment (MFJ)*** which set the rules for the AT&T divestiture. *U.S. v. AT&T, Modification of Final Judgment*, 552 F. Supp. 131 (D.D.C. 1982), *aff'd mem.*, 103 S.Ct.1240 (1983). *U.S. v. Western Electric*, Civil Action No. 82-0192, *AT&T Plan of Reorganization* (December 16, 1982), at page 10, n. 9; for definition of a POP, see page 12, n. 11. Submitted by AT&T pursuant to *MFJ*, at Section I (A), page 226; Section VIII(J), page 232. For a discussion, see *Behind the Telephone Debates*, pages 127-131.

13. *AT&T and the Bell System Operating Companies Tariff No. 8 (BSOC 8), Transmittal No. 53, Exchange Network Facilities for Interstate Access (ENFIA)*, CC Docket No. 78-371, *Memorandum Opinion and Order*, 71 FCC 2d 440 (1979); *Memorandum Opinion and Order*, 90 FCC 2d 6 (April 14, 1982); *Memorandum Opinion and Order*, 90 FCC 2d 202 (April 30, 1982); *Memorandum Opinion and Order*, 91 FCC 2d 1079 (September 1982); *Order on Reconsideration*, 93 FCC 2d 739 (1983).

14. In some cases, an ESP company may use a trunk side port to connect to the LEC switch. Here, the connection is similar to a business with a private line connection. Also, ESPs, like any other customer or company, may purchase ***Foreign Exchange (FX)*** service, which gives line side connections to a switch beyond the first switch (the central office switch).

15. Another way to look at blocking is to envision a highway with the trunks as lanes. If all the lanes are full, the call coming from the loop is blocked and can't go through.

16. Based on data used to develop the large and small switch definitions described in **Section IX, Appendix D**.

17. More than one loop will connect to a line concentration module. This module groups originating calls through the line group controller onto the switching module. A line concentrator is different from a multiplexer.

18. Find/SVP, *The American Internet User Survey*, The Emerging Technologies Research Group, New York, NY, February 1996. All numbers are for mid-November to mid-December 1995. From personal communication on March 21, 1996, page iv. There is also controversy over the actual number of Internet users and other related Internet statistics. **Figure 4** uses a conservative estimate. See **Section IX, Appendix D** for additional statistics and background.

19. This average is based on *all* switched voice calls, including access to the Internet over telephone modems, and ignores fixed connections, such as those for private line services.

20. "In North America, a geographic division within which telephone directory numbers are subgrouped. A 3-digit, N0/1X or NXX code is assigned to each NPA, where
    - N - any digit 2 through 9
    - 0/1 - 0 or 1
    - X - any digit 0 through 9."

The NXX format "embodies the concept of interchangeable codes, wherein central office codes and area codes [are] no longer...characterized by mutually exclusive formats." Bell Telephone Laboratories, Inc., *Engineering and Operations in the Bell System*, Prepared by Members of the Technical Staff and the Technical Publication Department, New Jersey, 1977, pages 112 and 673.

This projection is on a study about when the North American Numbering Plan (NANP) will exhaust the supply of 10-digit telephone numbers. Jim Deak, NANP Administration, Industry Numbering Committee (a standing committee under the Industry Carriers Compatibility Forum, or ICCF), NANP Expansion Workshop, "NANP Exhaust Projections," November 2, 1995, pages 1 and 2. This projection is based on the current rate of new area code assignments. Changes in this pattern will alter the exhaust date.

21. From isolated engineering reports.

22. For example, often calls from fax machines are short-burst, one-page transmissions. Credit card verifications, where the merchant swipes a card through a terminal to validate a transaction, may take only ten to twenty seconds. Another example is the use of point sale debit cards in lieu of checks. An instantaneous electronic transfer of funds moves money from the customer's bank account to the store's bank account. Pacific Bell, *Petition for Rulemaking* to the FCC, *In the Matter of Pacific Bell Petition for Rulemaking to Amend Section 69.106 of the Commission's Rules*, RM8496, June 30, 1994, Section III, "Proliferation of Short Calls," pages 3-6.

23. *Telecommunications Act of 1996*, Sec. 251(c)(2)(B).

24. *Ibid.*, Sec. 251(c)(2)(D). The universal service description for access to advanced services for specified schools, hospitals, etc., includes the terms "technically feasible and economically reasonable." Sec. 254(h)(2).

25. *Ibid.*, Sec. 251(c)(2)(C).

26. Hatfield Associates, Inc., *Open Network Architecture: A Promise Not Realized*, prepared for ADAPSO, Computer and Business Equipment Manufacturers Association, CompuServe Incorporated, Dun & Bradstreet, Independent Data Communications Manufacturers Association, Inc., and Telenet Communications Corporation; Boulder, CO, April 4, 1988.

27. FCC, *Interconnection Proceeding*, ¶97, "The Commission *could require* incumbent LECs to provide access to feeder and to distribution plant on an unbundled basis at remote switching or concentration sites, in addition to access to the switching or concentration equipment itself" [emphasis added].

Notes: Section III, Percent of Total Switch Investment by Company/Customer

28. When several services share a piece of equipment, economists do not simply consider the equipment's costs to be common costs. Instead, economists examine how the services affect the equipment's costs. If adding a service or increasing the use of a service increases the equipment's costs, this cost increase is an incremental cost to the service, even if the equipment is shared by multiple services.

29. The AIN employs off-network computers and databases for services. For example, a large business with stores in many locations may have a single telephone number. The AIN routes incoming calls from customers to the nearest store.

30. There are some exceptions where up to 8,000 lines can be connected to one line concentration module.

Notes: Section IV, Different Price Structures by Type of Company

31. For example, large business customers can shop for tariffs with the best price. The customer decides whether the state or interstate price is cheaper. Since the state/interstate information is not recorded, it's the customer's decision to report the actual traffic or to report the one that's cheaper, regardless of reality. As part of implementing the Act, there will be a debate as to which of these methods, if any, will continue to apply.

32. *Telecommunications Act of 1996*, Sec. 251(c)(B) and (D).

33. *Telecommunications Act of 1996*, Sec. 252 (d)(1)(A) and (B).

34. *MTS and WATS Market Structure Inquiry*, CC Docket No. 78-72, *Phase I: Third Report and Order (Access Charge Order)*, 93 FCC 2d 241 (1982) [hereinafter referred to as *Access Charge Proceeding*]. For the full citation of this proceeding, see *Behind the Telephone Debates*, pages 191-193. For a discussion of the access charge proceeding and the introduction of the CCLC and the SLC, see pages 115-118.

35. Transport charges from a tandem switch also include a per minute tandem switching charge and a per minute tandem transport.

36. The *Interconnection Proceeding*, ¶ 139, refers to a ***Transport Interconnection Charge (TIC)***, which is just another name for the RIC.

37. For details on these subsidy mechanisms, see Carol Weinhaus; Bob Lock; et al., *Overview of Universal Service, Presentation at the Communications Media Center, New York Law School*, December 6, 1995, Telecommunications Industries Analysis Project, Boston, MA, 02138. Carol Weinhaus; Sandra Makeeff; et al., *What is the Price of Universal Service? Impact of Deaveraging Nationwide Urban/Rural Rates*, Presentation at the National Association of Regulatory Utility Commissioners Meeting, San Francisco, California, July 25, 1993, Telecommunications Industries Analysis Project, Boston, MA, 02138. For details on the RIC, see Carol Weinhaus; Mark Jamison; et al., *New Wine and Old Wineskins: Modeling Effects of Competition and Expanded Interconnection in the Local Exchange*, Presentation at the National Association of Regulatory Utility Commissioners Meeting, Seattle, Washington, July 27, 1992. Carol Weinhaus; Sandra Makeeff; et al., *Who Pays Whom? Cash Flow For Some Support Mechanisms and Potential Modeling of Alternative Telecommunications Policies*, Presentation at the National Association of Regulatory Utility Commissioners Meeting, Los Angeles, California, November 15, 1992.

38. The SLC is also called the ***End User Common Line Charge (EUCLC)***.

39. This does not include private line services.

40. A private line is a dedicated connection between two customer locations or a dedicated connection from a customer's location to the long distance network. For example, private lines use LEC facilities to reach a specific destination. A private line service guarantees a given capacity and service quality throughout the leased facilities without specifying how the LEC actually routes the traffic.

41. This was true at the time of the AT&T breakup. The AT&T *Plan of Reorganization* that states "exchange functions...include sending dial tones, interpreting customer dialing, providing ringing or busy tones for incoming calls, connecting customer lines to interoffice trunks and recording information for billing purposes. This description applies only to ordinary local telephone service; certain specialized switching (e.g. 800 service) is not considered an end office [exchange] function." pages 14-15. For a discussion, see *Behind the Telephone Debates*, page 218, endnote 8.

42. Traditionally 800 services were only offered to business customers except, for the movie star Elizabeth Taylor, who had a residential 800 number. Recently some companies are making these services available to consumers.

43. "A cellular system is a *common carrier* and not merely a customer; interconnection arrangements should therefore be reasonably designed so as to minimize unnecessary duplication of switching facilities and the associated cost to the ultimate consumer. The particular arrangements involved in interconnection of a given cellular system should be *negotiated* among the carriers involved and be made the subject of an interexchange carrier agreement" [emphasis added]. *In the Matter of An Inquiry into the Use of the Bands 825-845 MHZ and 870-890 MHZ for Cellular Communications Systems; and Amendment of Parts 2 and 22 of the Commission's Rules Relative to Cellular Communications Systems* [hereinafter cited as *Cellular Docket*], CC Docket No. 79-318, *Report and Order*, FCC No. 81-161, May 4, 1981, ¶ 56.

    "We shall expect all telephone companies to furnish appropriate interconnection to cellular systems upon reasonable demand, however, and upon terms no less favorable than those offered to the cellular systems of affiliated entities or *independent telephone companies* [emphasis added]." *Ibid.*, ¶ 57.

44. In New York, cellular companies are compensated for terminating wireline (landline) calls. NY PSC, Case 93-C-0103, *Petition of Rochester Telephone Corporation for Approval of Proposed Restructuring Plan*, and Case 93-C-0033, *Petition of Rochester Telephone Corporation for Approval of a New Multi Year Rate Stability Agreement*, Opinion No. 94-25, *Opinion and Order Approving Joint Stipulation and Agreement*, November 10, 1994. NY PSC, Case 92-C-0665, *Performance-Based Incentive Regulatory Plans for New York Telephone Company — Track II, Order Approving Performance Regulatory Plan Subject to Modification*, June 16, 1995.

45. "The Commission's general interconnection policy for cellular systems,...is that telephone companies are required to provide...a form of interconnection...to be *negotiated* by the cellular carrier and the wireline telephone company....A cellular system operator is a *common carrier*, rather than a customer or end user, and as such is entitled to interconnection arrangements that 'minimize unnecessary duplication of switching facilities and the associated costs to the ultimate consumer" [emphasis added]. *In the Matter of the Need to Promote Competition and Efficient Use of Spectrum for Radio Common Carrier Services, Memorandum Opinion and Order*, FCC No. 86-85, March 5, 1986, Appendix B, ¶ 2.

"Compensation may, however, be paid under contract or tariff provided that the tariff is not an access tariff treating cellular carriers as interexchange carriers." *Ibid.*, ¶ 5.

46. FCC, *In the Matter of Implementation of Sections 3(n) and 332 of the Communications Act, Regulatory Treatment of Mobile Services*, GN Docket No. 93-252, *Second Report and Order*, FCC Order No. 94-31, March 7, 1994, ¶ 227-239.

47. The FCC generally requires Type II rates to be lower than Type I rates. "Certain distinctions between Type 1 and Type 2 interconnection produce differences in their respective costs....In most cases, the provision of Type 2 interconnection should be less expensive than the provision of Type 1." FCC, *In the Matter of the Need to Promote Competition and Efficient Use of Spectrum for Radio Common Carrier Services (Cellular Interconnection Proceeding)*, Report No. CL-379, *Memorandum Opinion and Order on Reconsideration*, FCC No. 89-60, 4 FCC Rcd No. 6, March 15, 1989, ¶ 30 and 34.

48. The FCC is currently examining LEC-CMRS interconnection, including bill and keep arrangements. FCC, *In the Matter of Interconnection between Local Exchange Carriers and Commercial Mobile Radio Service Providers*, CC Docket No. 95-185 and CC Docket No. 94-54, *Notice of Proposed Rulemaking*, January 11, 1996.

49. "In this order we also retain the current enhanced service provider (ESP) exemption in its current form." FCC, *In the Matter of Amendments of Part 69 of the Commission's Rules Relating to the Creation of Access Charge Subelements for Open Network Architecture* [hereinafter cited as *ONA Proceeding*], CC Docket No. 89-79, *Policy and Rules concerning Rates for Dominance Carriers*, CC Docket No. 87-313, *Report and Order and Order on Further Reconsideration and Supplemental Notice of Proposed Rulemaking*, July 11, 1991, ¶ 1. The ESP exemption is defined in the *ONA Proceeding, Notice of Proposed Rulemaking*, 4 FCC Rcd at 3983, ¶ 29-30, (1989). The FCC permits the ESPs to use local business lines or other state-tarrifed forms of access for their interstate traffic, thereby exempting them from federal access charges. "As a result, many ESPs currently pay state-tariffed business line rates and subscriber line charges for their switched interstate access connections." ¶ 30.

50. In its *Expanded Interconnection Proceeding*, the FCC stated that "central office collocation of ESP equipment is not essential to ensuring fair competition in the provision of enhances services," and that "given the much greater variety of ESP equipment, expanding this [expanded interconnection] requirement to include such equipment would cause significantly greater burdens, however. As a result, we decline to modify *Computer III* to require the LECs to permit collocation of ESP equipment." *In the Matter of Expanded Interconnection with Local Telephone* [hereinafter cited as *Expanded Interconnection Proceeding*], CC Docket No. 91-141, and *Amendment of the Part 69 of General Support Facility Costs*, CC Docket No. 92-222, *Report and Order and Notice of Proposed Rulemaking*, FCC No. 92-440, October 19, 1992, ¶93 - 94.

X. Notes, cont.

Notes: Section V, Summary

51. "If a television signal will require 45 mbps [megabits per second]...and local telephone service is priced at a penny a minute — the marginal cost of an intraLATA call — a two hour movie would cost $843.75 just for transmission....Alternatively, if the broadband video transport is priced at a flat rate of $15 per month — comparable to basic cable television rates today — then flat rate loop telephone service would be priced at two cents per month." Robert M. Pepper, *Through the Looking Glass: Integrated Broadband Networks, Regulatory Policies, and Institutional Change*, Office of Plans and Policy, FCC, Washington, DC, November 1988, OPP Working Paper No. 24, page 47.

Notes: Section VI, Appendix A: Monopoly/Competition Time Line

52. The first telephone patent was issued in 1875 and the second patent was issued in 1877. Patent law protected the Bell Telephone Company from competition from Western Union and independent carriers. In return, the Bell Company "agreed not to compete with Western Union in the public message-lowercase telegraph field." Bell Telephone Laboratories, Inc., *A History on Engineering and Science in the Bell System: The Early Years (1875-1921)*, M.D. Fagen (Editor), 1975, pages 11-17, 30-31. For details on telephone history, see *Behind the Telephone Debates*, pages 6-14, and generally, Gerald Brock, *The Telecommunications Industry: The Dynamics of Market Structure*, Harvard University Press, Cambridge, MA, 1981.

53. *A History on Engineering*, pages 33 and 34.

54. *Communications Act of 1934*, Pub. L. No. 4, 57 tat. 5 (1943). An FCC investigation on the telephone industry conducted between 1934 and 1939 used the term "natural monopoly" to characterize the industry. *Report of the FCC on the Investigation of the Telephone Industry in the United States*, H.R. Doc. 340, 76th Cong., 1st. Sess. 602 (1939), page 597. See also *Behind the Telephone Debates*, pages 10-11.

55. Initially limited to government and semi-public institutions (such as airlines, electric utilities, and stock and commodity exchanges), this decision authorized in-house communications services for both voice and data transmission. These customers could also share privately owned transmission facilities. *Behind the Telephone Debates*, pages 13-14. FCC, *Allocation of Frequencies in the Bands above 890 Mc.*, FCC Docket No. 11866.

56. While this paper focuses on switch interconnection, the customer site is another interconnection point. At the same time the network was opening up to competition, there was also a move to open the terminal equipment market with the *Hush-A-Phone* (1957) and *Carterfone* (1968) court decisions. *Hush- A-Phone Corp. v. AT&T et al.*, FCC Docket No. 9189, *Decision and Order*, 20 FCC 391 (1955); *Decision and Order on Remand*, 22 FCC 112 (1957); and *Hush-A-Phone v. United States*, 238 F.2d 266 (D.C. Cir. 1956). *In the Matter of Use of the Carterfone Device in Message Toll Telephone Service*, FCC Docket Nos. 16942, 17073, *Decision and Order*, 13 FCC 2d 240 (1968); *Reconsideration Denied, Memorandum and Opinion Order*, 14 FCC 2d 571 (1968).

X. Notes, cont.

57. Key decisions include: *Execunet*, FCC Docket No. 20640, *Order*, FCC 75-799, July 2, (1975); *Decision*, 60 FCC 2d 25 (1976). *MCI Telecommunications Corp. v. FCC (Execunet I)*, 561 F. 2d 365 (D.C. Cir. 1977), *cert. denied*, 434 U.S. 1040 (1978); also *Execunet II*, 580 F. 2d 590 (D.C. Cir. 1978), *cert. denied*, 439 U.S. 980 (1978). *Bell System Tariff Offerings*, FCC Docket No. 19896, *Decision*, 46 FCC 2d 413 (1974), *aff'd*, 503 F.2d 1250 (3rd Cir. 1974); *cert.denied*, 422 U.S. 1026 (1974); *reh'g denied*, 423 U.S. 886 (1975). *Lincoln Telephone and Telegraph Company*, 72 FCC 2d 724, 74 FCC 2d 196 (1979), 78 FCC 2d 1219 (1980), *aff'd* 659 F.2d 365 (D.C. Cir.1981). *United Tel. Co., Memorandum Opinion and Order*, 77 FCC 2d 1015 (1980). *ENFIA. MCI Telecommunications Corp. v. FCC*, 712 F. 2d 517, 524 (D.C. Cir. 1983).

58. For a discussion of the decisions leading up to the concept of "access," see pages 13-14, and pages 219-220 of *Behind the Telephone Debates*. Also see Charles F. Phillips, Jr., *The Regulation of Public Utilities: Theory and Practice*, Public Utilities Reports, Inc., Arlington, VA, 1993, pages 806-807, footnotes 127-131 for additional discussion and cites to key decisions.

59. *Access Charge Proceeding*.

60. *Access Charge Proceeding, ONA Proceeding*, and *Expanded Interconnection Proceeding*.

61. Formerly called Commercial Mobile Radio Services (CMRS).

62. Conversely, with wireline services, the communications appliance used by the customer is linked to a network by wires, such as copper wire, coaxial cable, and/or fiber optic cable. For a discussion of the evolution of mobile services, see the *PCS Primer*.

63. FCC, *In the Matter of Amendment of commission's Rules to Establish New Personal Communications Services* (hereinafter referred to as the *PCS Docket*), GEN Docket No. 90-314, *Notice of Proposed Rule Making and Tentative Decision*, FCC No. 92-333, August 14, 1992, ¶ 29, page 14. Also, *Memorandum Opinion and Order*, FCC No. 94-144, June 13, 1994, ¶ 2, page 3.

64. The court decision was in 1982, but the actual divestiture took place in 1984, *MFJ*. *Behind the Telephone Debates*, page 10.

65. Teleport has been in operation in New York City since 1985. The CAP connected to the IXC's point of interconnection (called a *point of presence, or POP*) with the LEC. This was called special access. Also, another early CAP, called LOCATE, started service in New York City, Detroit, Boston, and Chicago in 1983 according to the Yankee Group, *A CAP Market Update: No Future for the Independents?*, pages 6-17, 1993.

66. In its *Order Instituting Proceeding*, February 10, 1994, Case 94-C-0095, the NY PSC required pending completion of "Competition II" providing that carriers seeking certification to provide local service meet the same requirements imposed on the ILECs. On October 4, 1993, Case 92-C-0665, the NY PSC declared that MFS and Teleport were eligible for NXX codes (MFS and Teleport claimed this made them "LECs") but were not allowed to participate in reciprocal compensation.

67. Prior to the passage of the *Telecommunications Act of 1996*, a few of the smaller electric utilities, such as municipally owned Glasgow (Kentucky) Electric Plant Board, provided telecommunications or cable services; however, the *Public Utility Holding Company Act*, Title I,

prohibited most major utility companies from providing telecommunications services. *The Public Utility Act of 1935*, Pub. L. No. 74-333, 49 Stat. 803 (1935), also known as the *Wheeler-Rayburn Act.*

Some electric utility companies already use fiber optic lines for their internal voice and data communications needs and are planning on expanding their fiber optic networks for the more efficient management of electrical supply networks. In a move to tailor their products to individual customer needs, these companies are starting to string fiber to the home (the equivalent of a loop in telecommunications terms) and can provide telecommunications and information services once they are authorized as "exempt telecommunications companies" by the FCC pursuant to Section 34 of the 1996 *Act.*

Notes: Section IX, Appendix D: Switch Modeling Definitions and Assumptions

68. DS-1, or Digital Service 1, is 1.544 mbps (the bandwidth at which voice/data flows through the switch using copper or fiber technology). DS-30, or Digital Service 30, is 45 mbps (the bandwidth at which voice/data flows through the switch using copper or fiber technology); also referred to as DS-3. DS-512, or Digital Service 512 is 782 mbps (the bandwidth at which voice/data flows through transport facilities using fiber technology).

Appendix 2: Project Information

Project Information

List of Participants in the Telecommunications Industries Analysis Project

State Regulators	NARUC representatives from: Florida Public Service Commission Illinois Commerce Commission Iowa Utilities Board Massachusetts Department of Public Utilities New York Public Service Commission Ohio Public Utilities Commission Washington Utilities and Transportation Commission
Regional Holding Companies	Bell Atlantic BellSouth NYNEX SBC Communications Inc. US WEST
Independents	GTE Kalona Cooperative Telephone Sprint Local Telecom Division
Interexchange Carriers	AT&T Sprint
Cellular and Wireless Carriers	360° Communications
Foreign Domestics	InfoCom Research, Inc. NTT America
Local, National, and International Services	BT France Telecom North America
Materials Manufacturers	Corning
Academic	University of Florida

Sponsors:

Corporation for Public Broadcasting

Assisting with *public* data:

Bellcore
Federal Communications Commission
National Exchange Carrier Association
National Telecommunications and Information Administration

Project Information, cont.

Background on the Telecommunications Industries Analysis Project

The goal of the Telecommunications Industries Analysis Project is to provide information to support the development of alternative communications policies to meet the needs of stakeholders in an environment that includes competitive and non-competitive markets, federal and state regulatory jurisdictions, and a proliferation of new services made possible by technological advances. The purpose of the project is to produce research and analysis which will assist policy makers in making informed decisions.

The project is a neutral forum of communications industry stakeholders exploring multiple viewpoints of selected issues. This forum incorporates the following elements:

- **Broad representation:** The current forum includes foreign and domestic local exchange carriers (LECs), interexchange carriers (IXCs), materials and equipment manufacturers, and federal and state regulators. The project actively seeks expansion of this forum to include other communications industry representatives such as competitive access providers, cable television companies, computer companies, electric power utilities, or publishers.

- **Multiple viewpoints:** Participants are required to play an active role in the research and analysis, to represent their own interests, to understand and to assist in developing others' perspectives, and to work toward the common goal of representing multiple views. Since papers reflect multiple viewpoints and ideas, authors and reviewers may not agree with particular views or approaches expressed in the papers. The objective is to lay out ideas and options to assist policy makers in their decisions.

- **Analysis and results of alternative policies:** Research tools, including a jointly produced data base and computer software models, and data analysis developed by this forum create a common language for examining issues. The common language allows the participants to focus on underlying issues. Appropriate computer software tools, including modifications to existing tools, are developed.

- **All data, analysis methods, and results are public:** Data used by this project must be publicly available on a nationwide basis. Research products become public domain information.

- **Neutral setting:** The project resides in a neutral setting, free of partiality, thereby ensuring objective and independent research.

The views expressed in this paper are those of the Telecommunications Industries Analysis Project. The information in this paper is intended to provide general public information and does not constitute or foretell the official position of any of the parties who contributed to this paper. The opinions expressed in this paper do not necessarily reflect the views of the FCC or of any other agency or institution.